

Application No. 10/675,419
Response dated February 9, 2007
to Final Office Action mailed October 11, 2006

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method for developing a resist film formed on a substrate, the method comprising the steps of:
 - applying a sacrificial surfactant-containing liquid onto the resist film to pre-wet the resist film;
 - displacing the sacrificial surfactant-containing liquid film with a developing solution of selected concentration; and
 - developing the resist film using the developing solution.
2. (Currently Amended) The method as claimed in claim 1, the method further comprising: determining a concentration for the sacrificial surfactant-containing liquid based on one or more characteristics of the resist film.
3. (Currently Amended) The method as claimed in claim 1, wherein the sacrificial surfactant-containing liquid comprises at least one of an ionic surfactant, a nonionic surfactant, an anionic surfactant, and a cationic surfactant.
4. (Currently Amended) The method as claimed in claim 1, the method further comprising: determining a concentration for the sacrificial surfactant-containing liquid based on the resist film and selecting the concentration for the developing solution based on one or more characteristics of the sacrificial surfactant-containing liquid and the resist film.
5. (Currently Amended) The method as claimed in claim 1, the method further comprising: determining a contact angle for the developing solution on the resist film; and determining a concentration for the sacrificial surfactant-containing liquid effective to achieve a decrease in the contact angle.

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6. (Currently Amended) The method as claimed in claim 1, the method further comprising:
prior to applying the sacrificial surfactant-containing liquid, transferring the substrate
having the resist film thereon into a developing unit; and
positioning the substrate on a spin chuck,
wherein the applying and displacing are performed while rotating the spin chuck.

7. (Original) The method as claimed in claim 6, wherein the developing includes allowing the
developing solution to stand on the resist film for a prescribed time sufficient to permit a
developing reaction to proceed, and wherein the method further comprises:

after the developing, rinsing the substrate while rotating the spin chuck.

8. (Original) The method as claimed in claim 7, the method further comprising:
after the rinsing, drying the substrate while rotating the spin chuck; and
transferring the substrate out of the developing unit.

9. (Currently Amended) The method as claimed in claim 1, wherein an exposed portion and
an unexposed portion of the resist film have a difference in solubility, the method further
comprising:

determining a concentration for the sacrificial surfactant-containing liquid based on at
least one of the solubility of the exposed portion of the resist film and solubility of the unexposed
portion of the resist film.

10. (Currently Amended) The method as claimed in claim 1, the method further comprising:
determining a concentration for the sacrificial surfactant-containing liquid based on the
water solubility of the resist film.

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11. (Currently Amended) The method as claimed in claim 1, further comprising rotating the substrate during the step of applying, and wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a nozzle capable of depositing the sacrificial surfactant-containing liquid in a substantially circular shape, the nozzle being positioned over the center of the substrate while depositing the sacrificial surfactant-containing liquid onto the rotating substrate.

12. (Currently Amended) The method as claimed in claim 1, wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a nozzle capable of depositing the sacrificial surfactant-containing liquid in substantially a band shape, the nozzle being scanned over the substrate while depositing the sacrificial surfactant-containing liquid.

13. (Currently Amended) The method as claimed in claim 1, wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a plurality of nozzles each capable of depositing the sacrificial surfactant-containing liquid in substantially a band shape, the plurality of nozzles being scanned over the substrate while depositing the sacrificial surfactant-containing liquid.

14. (Currently Amended) The method as claimed in claim 1, further comprising rotating the substrate during the step of displacing, and wherein the step of displacing the sacrificial surfactant-containing liquid with a developing solution is carried out by using a nozzle capable of depositing the developing solution in a substantially circular shape, the nozzle being positioned over the center of the substrate while depositing the developing solution onto the rotating substrate.

15. (Currently Amended) The method as claimed in claim 1, wherein the step of displacing the sacrificial surfactant-containing liquid with a developing solution is carried out using a

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nozzle capable of depositing the developing solution in a substantially band shape, the nozzle being scanned over the substrate while depositing the developing solution.

16. (Currently Amended) The method as claimed in claim 1, wherein the step of displacing the sacrificial surfactant-containing liquid with a developing solution is carried out by using a plurality of nozzles each capable of depositing the concentration-adjusted developing solution in substantially a band shape, the plurality of nozzles being scanned over the substrate while depositing the developing solution.

17. (Currently Amended) The method as claimed in claim 1, wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a nozzle capable of depositing the sacrificial surfactant-containing liquid in dropwise fashion, the nozzle being positioned over the center of the substrate while depositing at least one drop of the sacrificial surfactant-containing liquid onto the substrate while rotating the substrate.

18. (Currently Amended) The method as claimed in claim 1, the method further comprising:
selecting the concentration of the developing solution in accordance with one or more characteristics of the sacrificial surfactant-containing liquid and the resist film.

19. (Original) The method as claimed in claim 1, wherein the developing includes rotating the substrate having the developing solution supplied thereto for a prescribed time sufficient to permit a developing reaction to proceed.

20. (Currently Amended) A method for processing of a resist film formed on a substrate, the method comprising the steps of:
depositing a resist film on the substrate;

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applying a sacrificial surfactant-containing liquid onto the resist film to pre-wet the resist film, wherein the sacrificial surfactant-containing liquid is chosen based on one or more characteristics of the resist film;

selecting a concentration of a developing solution in accordance with one or more characteristics of the sacrificial surfactant-containing liquid and the resist film;

supplying the developing solution onto the resist film after applying the sacrificial surfactant-containing liquid on the substrate to displace the sacrificial surfactant-containing liquid;

developing the resist film by allowing the substrate having the developing solution supplied thereto to stand for a prescribed time sufficient to permit a developing reaction to proceed; and

thereafter, rinsing the substrate.

21. (Currently Amended) The method as claimed in claim 20, wherein the sacrificial surfactant-containing liquid comprises at least one of an ionic surfactant, a nonionic surfactant, an anionic surfactant, and a cationic surfactant.

22. (Currently Amended) The method as claimed in claim 20, the method further comprising:
determining a concentration for the sacrificial surfactant-containing liquid based on the resist film thickness.

23. (Currently Amended) The method as claimed in claim 20, the method further comprising:
determining a concentration for the sacrificial surfactant-containing liquid based on the resist film and one or more characteristics of selecting the concentration of the developing solution based on the concentration of the sacrificial surfactant-containing liquid.

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24. (Currently Amended) The method as claimed in claim 20, the method further comprising:
determining a concentration for the sacrificial surfactant-containing liquid based on the water solubility of the resist film.

25. (Currently Amended) The method as claimed in claim 20, the method further comprising:
determining a contact angle for the developing solution on the resist film; and
determining a concentration for the sacrificial surfactant-containing liquid effective to achieve a decrease in the contact angle.

26. (Currently Amended) The method as claimed in claim 20, the method further comprising:
prior to applying the sacrificial surfactant-containing liquid, transferring the substrate having the resist film thereon into a developing unit; and
positioning the substrate on a spin chuck, wherein the applying and supplying are performed while rotating the spin chuck.

27. (Original) The method as claimed in claim 26, the method further comprising:
after the rinsing, drying the substrate while rotating the spin chuck; and
transferring the substrate out of the developing unit.

28. (Currently Amended) The method as claimed in claim 20, further comprising rotating the substrate during the step of applying, and wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a nozzle capable of depositing the sacrificial surfactant-containing liquid in a substantially circular shape, the nozzle being positioned over the center of the substrate while depositing the sacrificial surfactant-containing liquid onto the rotating substrate.

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29. (Currently Amended) The method as claimed in claim 20, wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a nozzle capable of depositing the sacrificial surfactant-containing liquid in substantially a band shape, the nozzle being scanned over the substrate while depositing the sacrificial surfactant-containing liquid.

30. (Currently Amended) The method as claimed in claim 20, wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a plurality of nozzles each capable of depositing the sacrificial surfactant-containing liquid in substantially a band shape, the plurality of nozzles being scanned over the substrate while depositing the sacrificial surfactant-containing liquid.

31. (Currently Amended) The method as claimed in claim 20, further comprising rotating the substrate during the step of supplying, and wherein the step of supplying the developing solution onto the resist film is carried out by using a nozzle capable of depositing the developing solution in a substantially circular shape, the nozzle being positioned over the center of the substrate while depositing the sacrificial surfactant-containing liquid onto a rotating substrate.

32. (Original) The method as claimed in claim 20, wherein the step of supplying the developing solution onto the resist film is carried out by using a nozzle capable of depositing the developing solution in a substantially band shape, the nozzle being scanned over the substrate while depositing the developing solution.

33. (Original) The method as claimed in claim 20, wherein the step of supplying the developing solution onto the resist film is carried out by using a plurality of nozzles each capable of depositing the developing solution in substantially a band shape, the plurality of nozzles being scanned over the substrate while depositing the developing solution.

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34. (Currently Amended) The method as claimed in claim 20, wherein the step of applying a sacrificial surfactant-containing liquid onto the resist film is carried out by using a nozzle capable of depositing the sacrificial surfactant-containing liquid in dropwise fashion, the nozzle being positioned over the center of the substrate while depositing at least one drop of the sacrificial surfactant-containing liquid onto the substrate while rotating the substrate.

35. (Original) The method as claimed in claim 20, wherein the substrate having the developing solution supplied thereto is rotated for at least a portion of the prescribed time.

36. Canceled.